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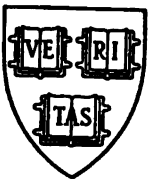

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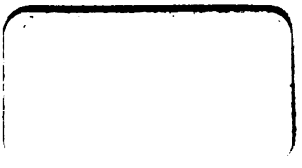

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THE GEOLOGICAL MAPS OF ENGLAND AND WALES

On the scale of one inch to a mile.

(With explanatory Horizontal and Vertical Sections, and Memoirs.)

COMPLETED COUNTIES.

For particulars see the detailed Catalogue.

The Sheets marked * have Descriptive Memoirs.
Those marked † are illustrated by general Memoirs.

ANGLESEY,—sheets 77 (N), 78. Horizontal Sections, sheet 40.

BEDFORDSHIRE,—sheets 46 (NW, NE, SW†, & SE†), 52 (NW, NE, SW, & SE).

BERKSHIRE,—sheets 7*, 8†, 12*, 13*, 34*, 45 (SW*). Horizontal Sections, sheets 59, 71, 72, 80.

BRECKNOCKSHIRE,—sheets 36, 41, 42, 56 (NW & SW), 57 (NE & SE). Horizontal Sections, sheets 4, 5, 6, 11; and Vertical Sections, sheets 4 and 10.

BUCKINGHAMSHIRE,—7*, 13*, 45* (NE, SE), 46 (NW, SW†), 52 (SW). Horizontal Sections, 74, 79.

CAERMARTHENSHIRE,—37, 38, 40, 41, 42 (NW & SW), 56 (SW), 57 (SW & SE). Horizontal Sections 2, 3, 4, 7, 8, 9; and Vertical Sections 3, 4, 5, 6, 13, 14.

CAERNARVONSHIRE,—74 (NW), 75, 76, 77 (N), 78, 79 (NW & SW). Horizontal Sections, 28, 31, 40.

CARDIGANSHIRE,—40, 41, 56 (NW), 57, 58, 59 (SE), 60 (SW). Horizontal Sections, 4, 5, 6.

CHESHIRE,—73 (NE & NW), 79 (NE & SE), 80, 81 (NW* & SW*), 88 (SW). Horizontal Sections 18, 43, 44, 60, 64, 65, 67, 70.

CORNWALL,—24†, 25†, 26†, 29†, 30†, 31†, 32†, & 33†.

DENBIGH,—73 (NW), 74, 75 (NE), 78 (NE & SE), 79 (NW, SW, & SE), 80 (SW). Horizontal Sections 31, 35, 38, 39, 43, 44; and Vertical Sections, sheet 24.

DERBYSHIRE,—62 (NE), 63 (NW), 71 (NW, SW, & SE), 72 (NE, SE), 81, 82, 88 (SW, SE). Horizontal Sections 18, 46, 60, 61, 69, 70.

DEVONSHIRE,—20†, 21†, 22†, 23†, 24†, 25†, 26†, & 27†. Horizontal Sections, sheet 19.

DORSETSHIRE,—15, 16, 17, 18, 21, 22. Horizontal Sections, sheets 19, 20, 21, 22, 56. Vertical Sections, sheet 22.

FLINTSHIRE,—74 (NE), 79. Horizontal Sections, sheet 43.

GLAMORGANSHIRE,—20, 36, 37, 41, and 42 (SE & SW). Horizontal Sections, sheets 7, 8, 9, 10, 11; and Vertical Sections, sheets 2, 4, 5, 6, 7, 9, 10, 47.

GLOUCESTERSHIRE,—19, 34*, 35, 43 (NE, SW, & SE), 44*. Horizontal Sections 12, 13, 14, 15, 59; and Vertical Sections 7, 11, 15, 46, 47, 48, 49, 50, 51.

HAMPSHIRE,—8†, 9, 10*, 11, 12*, 14, 15, 16. Horizontal Section, sheet 80.

HEREFORDSHIRE,—42 (NE & SE), 43, 55, 56 (NE & SE). Horizontal Sections 5, 13, 27, 30, 34; and Vertical Sections, sheet 15.

KENT,—1† (SW & SE), 2†, 3†, 4*, 5, 6†. Horizontal Sections, sheets 77 and 78.

MERIONETHSHIRE,—59 (NE & SE), 60 (NW), 74, 75 (NE & SE). Horizontal Sections, sheets 26, 28, 29, 31, 32, 35, 37, 38, 39.

MIDDLESEX,—1† (NW & SW), 7*, 8†. Horizontal Sections, sheet 79.

MONMOUTHSHIRE,—35, 36, 42 (SE & NE), 43 (SW). Horizontal Sections, sheets 5 and 12; and Vertical Sections, sheets 8, 9, 10, 12.

MONTGOMERYSHIRE,—56 (NW), 59 (NE & SE), 60, 74 (SW & SE). Horizontal Sections, sheets 26, 27, 29, 30, 32, 34, 35, 36, 38, 107.

NORTHAMPTONSHIRE,—64, 45 (NW & NE), 46 (NW), 52 (NW, NE, & SW), 53 (NE, SW, & SE), 63 (SE), 64.

OXFORDSHIRE,—7*, 13*, 34*, 44*, 45*, 53 (SE*, SW). Horizontal Sections, sheets, 71, 72, 81, 82.

PEMBROKESHIRE,—38, 39, 40, 41, 58. Horizontal Sections, sheets 1 and 2; and Vertical Sections, sheets 12 and 13.

RADNORSHIRE,—42 (NW & NE), 56, 60 (SW & SE). Horizontal Sections, sheets, 5, 6, 27.

RUTLANDSHIRE,—this county is included in sheet 64.

SHROPSHIRE,—55 (NW, NE), 56 (NE), 60 (NE, SE), 61, 62 (NW), 73, 74 (NE, SE). Horizontal Sections, sheets 24, 25, 30, 33, 34, 36, 41, 44, 45, 53, 54, 58; and Vertical Sections, sheets 23, 24.

SOMERSETSHIRE,—18, 19, 20, 21, 27, 35. Horizontal Sections, sheets, 15, 16, 17, 20, 21, 22, 103, 104, & 105; and Vertical Sections, sheets 12, 46, 47, 48, 49, 50, and 51.

STAFFORDSHIRE,—54 (NW), 55 (NE), 61 (NE, SE), 62, 63 (NW), 71 (SW), 72, 73 (NE, SE), 81 (SE, SW). Horizontal Sections 18, 23, 24, 25, 41, 42, 45, 49, 54, 57, 58, 60; and Vertical Sections 16, 17, 18, 19, 20, 21, 23, 26.

SURREY,—1 (SW†), 6†, 7*, 8†, 9. Horizontal Sections, sheets 74, 75, 76, and 79.

SUSSEX,—4*, 5, 6, 8, 9, 11. Horizontal Sections, sheets 73, 75, 76, 77, 78.

WARWICKSHIRE,—44*, 45 (NW), 53*, 54, 62 (NE, SW, & SE), 63 (NW, SW, & SE). Horizontal Sections, sheets 23, 48, 49, 50, 51, 82, 83; and Vertical Sections, sheet 21.

WILTSHIRE,—12*, 13*, 14, 15, 18, 19, 34*, and 35. Horizontal Sections, sheets 15 and 59.

WORCESTERSHIRE,—43 (NE), 44*, 54, 55, 62 (SW & SE), 61 (SE). Horizontal Sections, 13, 23, 25, 50, and 59; and Vertical Section 15.

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48 S.E.

MEMOIRS OF THE GEOLOGICAL SURVEY.

ENGLAND AND WALES.

THE GEOLOGY OF THE EASTERN END OF ESSEX (WALTON NAZE AND HARWICH).

(EXPLANATION OF QUARTER SHEET 48 S.E. WITH THE ADJOINING PART OF 48 N.E.)

BY

WILLIAM WHITAKER, B.A., LOND., F.G.S.

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NOTICE.

THE publication of this short Memoir completes the geological descriptions of the area directly bordering the Estuary of the Thames, and may be looked upon as supplementary to Mr. Whitaker's longer Memoir on THE GEOLOGY OF THE LONDON BASIN, 1872.

I look upon the preservation of the well sections as of very great value.

ANDREW C. RAMSAY,
Director General.

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NOTICE.

THE eastern end of Essex (including the towns of Harwich and Walton-on-the-Naze), comprised in Quarter Sheet 48 S.E., was geologically surveyed by Mr. William Whitaker in the years 1871, 72.

This Explanation, also the work of Mr. Whitaker, is the first Memoir issued by the Geological Survey that notices the Crag, a formation remarkable palæontologically for its fossils; and valuable economically for the phosphatic deposits of so-called coprolites which it contains.

The lists of fossils have been revised by Mr. Etheridge F.R.S.

H. W. BRISTOW,
Senior-Director.

Geological Survey Office,
28 Jermyn Street, London, S.W.,
1st July 1876.

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THE

GEOLOGY OF THE EASTERN END OF ESSEX.

1. Introduction.

Area.

The tract included in Sheet 48, S.E. of the Geological Survey Map, together with the small slip of Essex in 48, N.E. is about 50 square miles in area. It forms part of the London Basin, and is bounded on the north by the estuary of the Stour, and on the east and south-east by the sea.

Streams.

The stream that rises in the neighbourhood of Wicks (in 48, S.W.) and Great Oakley flows north-westward to the Stour near Dovercourt; the estuary of the Hanford Water, rising west of Beaumont, occupies, with its branches, the space between Dovercourt and the Naze; and the stream rising on the east of Little Bromley (in 48, S.W.) flows south-eastward to the sea near Frinton, soon after receiving the stream running eastward from the Clactons (in 48, S.W.)

Formations.

The beds that occur at the surface in this tract are as follow:—

Post Glacial -	Blown Sand -	Coast.
	Sand and Shingle	Coast.
	Alluvium.	
	Loam or Brickearth.	
	Gravel and Sand.	
? Glacial - -	Gravel and Sand, and Loam.	
Pliocene - -	? Chillesford Beds (bedded loam, &c.)	
	Red Crag.	
Lower Eocene -	London Clay.	

Besides these, however, lower beds have been pierced in the deep wells, one of which at Harwich reaches even

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to Palæozoic rocks (see p. 23), the series thus continued beneath the London Clay being :—

Lower Eocene	-	Reading Beds.
Cretaceous	-	Chalk.
		Upper Greensand?
		Gault.
Palæozoic -	-	Carboniferous.

The occurrence of the slaty rock at the bottom of the Harwich boring shows the presence of an underground mass of older rocks which must have been above the sea in early Cretaceous times, for here the Lower Cretaceous beds are unrepresented. Moreover, the whole of the great Jurassic and New Red epochs are unrepresented; so that we are led to infer that the old ridge must have existed throughout nearly the whole of the Secondary period. That such an underground ridge of older rocks was present somewhere in the south of England was inferred by Mr. Godwin-Austen on theoretical grounds before its existence was actually proved.*

2. London Clay.

This well known clay not only forms the surface of the greater part of the district, but also everywhere underlies the newer beds. It is more or less bedded in structure and dark bluish-grey in colour, weathering brown. In this neighbourhood it is especially noted for the clayey limestone, or cement-stone, which sometimes occurs in the form of continuous layers and sometimes as isolated nodular masses, or septaria. It also contains a great many small nodules of iron-pyrites, (on decomposition causing an efflorescence of persulphate of iron), which are still collected on the beach near Walton for the manufacture of copperas, to the amount, I was informed, of about 150 tons a year. The cement-stone was formerly worked on the coast, for the manufacture of Roman cement, and was taken from the foreshore or dredged further out to such an extent as greatly to aid the sea in its encroachment on the land.

---

* *See* Guide to the Geology of London and the Neighbourhood, Ed. 2, pp. 15–18, Geological Survey Memoir, 1875.

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The following analysis of a septarian nodule from Walton was made by Mr. R. Phillips :*—

Carbonate of lime - - -	68·5
Silica - - - - -	14·4
Alumina - - - -	3·2
Oxide of iron, with a little manganese -	7·4
Water - - - - -	4·
Organic matter and loss - - -	2·5
	100·0

The London Clay is shown by its fossils to have been of marine origin, though the frequency of plant-remains in it in many places points to the nearness of land. In this district the plants are usually fossilised by iron-pyrites, but sometimes they occur as lignite. When the cement-stone was worked many remains of turtles were found in it, and indeed it is for these reptiles that the London Clay of Harwich was particularly noted. The number of species found in this district is, however, very small, the only safely recorded species (from Harwich) being those named at p. 26.

All the upper part of the London Clay has been removed by denudation, the greatest thickness known being about 120 feet (well-sections, p. 24), instead of 450 feet where the whole of the formation occurs, at Sheppey, on the south. If any part of the next overlying series, the Bagshot Beds, were deposited in this district, it also has been removed, for the London Clay is here succeeded by a much newer deposit, the Crag.

Inland this clay is rarely to be seen in section, the cuttings on the Tendring Hundred and Harwich Railways and the brickyards on the southern side of the former at Kirby Cross, and by the high road between Dovercourt and Harwich being the only artificial exposures that I know of; but natural sections occur all along the cliffs, both facing the sea and the River Stour, and the clay also crops out to a great extent along the foreshore, when it is locally known as "platimore." The best sections are along the cliffs on either side of Walton. It is there much jointed, so as to break up into small cuboidal pieces, and almost unfossiliferous. Some of the included cement-stones differ from ordinary septaria and are full of irregular vermiform bodies that weather out in relief.

* *Lond. Geol. Journ.* 1846. For an analysis of Harwich cement-stone, see *Geological Survey Memoirs*, vol. iv., p. 278.

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In 1704 S. Dale published an account of the cliff at Harwich in which he noticed the alternation of beds in the London Clay (see p. 15); and in 1829 the following section of the Barrack Cliff, was noted by the Rev. W. B. Clarke.*

		FT.
	Red gravel and sand - - - -	20
	Crag shells in fragments - - -	
London Clay	Mottled clay, white reddish and grey clays, bluish-grey and blue clay - - - -	
	Ten layers of green pyritous clay, each 1½ inches thick, in blue clay - - - -	20
	Thin layer of blue clay - - - -	
	Two layers of green pyritous clay - -	
	Blue clay with limestone [cement-stone] - -	
	Blue clay with two layers of pyritous green clay	
	Blue clay - - - - -	

In 1871 I noticed that, at the point (known as Beacon Cliff), there was a firm sandy bed near the top, whilst on the foreshore a bed of stone, about 6 inches thick, was very marked.

There are seven islands of London Clay in the Handford Estuary, the largest being Horsey, with Skipper's Island on the west; all these however rise but slightly above the alluvium that borders them, but a more marked and gravel-capped one occurs in the estuary of the Stour at Ramsey Ray, N.W. of Dovercourt. The still larger mass of the Naze, capped with Crag and gravel, may also be considered an island, as the alluvium at Walton seems to run across from the creek to the sea.

3. Red Crag.

General Description.

Of the "Lower," "White," or "Coralline" Crag there are no signs in Essex, except from the occurrence in the Red Crag of fossils derived from it; but of this latter one of the best localities is at the Naze.

The Red Crag is a sand, mostly coarse, false-bedded, and highly ferruginous; but besides this bright brownish-red sand there is here and there also some of a finer texture and lighter colour. It is in great part crowded with shells, often broken up. These mostly occur in the lower part, and their absence in the upper part has led some geologists to divide the Red Crag into two; but my own observations have led me to doubt the validity of

* *Trans. Geol. Soc.*, Ser. 2, vol. v., pp. 369, 370.

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this division, the absence of shells in the upper part seeming to be owing to their having been dissolved away by the action of carbonated water filtering through the beds, rather than to their not having been deposited. This question, however, can be more conveniently discussed when describing the Crag of Suffolk.

The fossils of the Red Crag are of two sorts, those that lived in the seas of the time, and those derived from older formations. To the latter belong those phosphatized bones, teeth, &c., that so often occur at the very base of the deposit, as well as various shells from the older Coralline Crag. The shells of the Red Crag point as a rule to shallow water conditions, and it would seem that the sea was not wholly free from floating ice. Mr. S. V. Wood, jun. regards the Red Crag as to a great extent a beach-deposit.*

Beaumont.

On the high ground at this village, which is at the western edge of Sheet 48, S.E., there is a covering of shelly Red Crag, which, though not hidden by Drift, yields no good section, the only exposures being in ponds, &c., in the neighbourhood of the large farm, close to the church.

The only notices I have seen of this patch of Red Crag are a pamphlet of 4 pages, by the late Mr. John Brown, of Stanway, apparently privately printed,† and a note by the same author of about the same date (‡) in which he remarks :—"It is very rich in the ordinary fossils of the Crag, and those singular [phosphatic] nodules occurring in this formation . . . . are very plentiful here." An analysis of some of these, made by Mr. R. Phillips, gives the following result :—

Phosphate of lime, with a little oxide of iron -	56·
Carbonate of lime - - - -	18·08
Silica - - - - - -	7·88
Alumina - - - - -	6·
Oxide of iron - - - - -	5·33
Carbonaceous matter - - - -	·44
Moisture - - - - -	4·
Loss - - - - - -	2·22
	100

* *Ann. Nat. Hist.*, Ser. 3, vol. xiii., p. (1864).

† A List of Fossils from a Deposit of Red Crag, in the Parish of Beaumont, Essex ; collected in 1845 and 1846.

‡ *Lond. Geol. Journ.*, p. 17 (1846).

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Walton Naze.

Though the patch of Crag, with its covering of gravel, on the higher part of the island or peninsula of the Naze is of no greater area that that at Beaumont (about a quarter of a square mile), yet from the cliff-section and the abundance of fossils afforded thereat, it is classic amongst Crag localities. There is moreover another reason for its celebrity, for the Messrs. Wood, whose names are inseparably connected with the Crag, consider this Walton mass to be the oldest Red Crag in our country.

Mr. S. V. Wood, jun., remarked in 1864, that "At Walton Naze . . . a bed of Red Crag occurs, lying on the London Clay, which differs entirely from any other Red Crag known. It is destitute of stratification, and is of a greyish-brown colour. It alone, of all the Red Crag beds, yields shells in the condition in which they died—bivalves not unfrequently with both valves united, and univalves with the pullus unimpaired. This bed . . . presents the only instance, other than that of the fifth stage, [his uppermost division of Red Crag] which has been deposited under water; and it is destitute of those derivative Coralline Crag shells that so largely contribute to make up the mass of the Red Crag."*

In his latest publication Mr. Wood (Sen.) remarks that "the only part of the Red Crag which is genuine and free from derivations is that of Walton Naze."† In the same work he gives the following table of the distribution in space of the Walton shells, after rejecting doubtful and derivate species:‡—

Species of Mollusca in the Walton Naze (or older) Red Crag	148
British and not Mediterranean species - - -	13
„ „ Mediterranean - „ - - -	61
Mediterranean and not British „ - - -	14
Neither British nor Mediterranean species - - -	10
Species not known living - - - - -	50

The number of Mediterranean species (75) seems to show that the colder conditions elsewhere shown by the Red Crag had not begun at the time of the Walton deposit.

Inland the Crag is shown in a pond on the western side of Walton Hall, and in an old pit nearly a quarter

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* *Ann. Nat. Hist.*, Ser. 3, vol. xiii., pp. 188, 189.
† Supplement to the Crag Mollusca, p. 198, Palæontographical Society, 1874.
‡ *Ibid*, p. 219.

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of a mile on the south, but, from the capping of gravel over the hill-top, the outcrop is very narrow; the cliff, however, on either side of Walton Tower, gives a section about half a mile long, through the Crag to the London Clay, the former moreover being generally divided from the gravel by a bedded loamy deposit, that seems to be allied to the "Chillesford Beds" of Suffolk, and has been classed as such by two of our chief authorities in Crag geology, Prof. Prestwich and Mr. S. V. Wood, jun. The following section has been made up from observations taken at many points. A full list of the fossils that have been found here is given at pp. 26-31.

Cliff-section at the Naze, 1871.

Clayey soil in parts.

Fine gravel; composition noted at p. 17; up to 7 feet or more.

? Chillesford Beds. Light-coloured (grey and brownish), more or less bedded sandy clay, loam, and clayey sand; here and there with flints, flint-pebbles, and quartz-pebbles, and sometimes a little sand; often with a layer of pale purplish clayey sand, sometimes a thin peaty layer (in places with well-preserved wood), and sometimes pebbles and flints at the bottom:—up to 7 feet

Red Crag {
- Brown and buff sand, false-bedded; sometimes with many small quartz-pebbles, and some small phosphatic nodules: 5 or 6 feet, but not constant, and sometimes passing into the bed below.
- Brown and grey sand with shells and ferruginous nodules, false-bedded; sometimes with thin layers of hardened clay and, in the upper part, many small black phosphatic nodules and small quartz-pebbles.
- Thin bed of phosphatic nodules and phosphatized bones at the bottom in places. Noticed by Mr. H. Stopes, F.G.S., in 1874. I was told in 1871 that about 10 tons of the so-called "coprolites," or phosphatic nodules, were collected yearly on the shore near Walton.

London Clay, brown at top, but soon getting grey.

It is not everywhere that all the beds above noted occur, as the Crag rests on an uneven surface of the London Clay, which therefore rises up sometimes through the lower beds, as noticed by Mr. S. V. Wood, jun., and Prof. Prestwich:* at one place, indeed, the gravel is only separated by a very little of the underlying loam from the London Clay, the beds of the Red Crag ending off in succession against a gentle slope of the last.

* *Quart. Journ. Geol. Soc.*, vol. xxii., p. 548 (1866); and vol. xxvii., p. 333 (1871).

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Between Handford Water and the Stour.

During the making of the Harwich Railway the "coprolite-bed" at the base of the Red Crag was found beneath the gravel in the cutting near Wrabness. When I was in the neighbourhood (in 1871–72) this was turfed over, and I could find no trace of the bed; but in 1875 it was reopened, for widening the line, and my colleague Mr. W. H. Dalton tells me that "in the "cutting at the station about four feet of thin-bedded "ironstone, with phosphatic nodules at the base, "occurred between the London Clay and the gravel.

North-eastward of Little Oakley I was able to map three patches of Red Crag. The largest of these stretches from near Oakley Cross, where it is mostly covered by gravel, to just beyond Foulton Hall. Another, quite hidden by gravel, occurs just north of the Rectory, its boundary being of course doubtful. The third is a little N.N.E. of Foulton Hall, and runs under the gravel on the west.

Between Ramsey and Dovercourt Red Crag occurs from a little west of South Hall for about three-quarters of a mile along the hill top E.N.E., but is in great part hidden by gravel. The shelly Crag is shown south of the Hall, and in the lane on the eastward, whilst just east of the Hall I saw, underneath the gravel, bedded sand and loam with ironstone.

About half a mile south of the Dovercourt Cement Works, on the hill overlooking Mill Bay, is a smaller patch, in which, however, there were two small sections of shelly Crag at the time of my visit.

Along the road on the top of the cliff further N.E. (before getting to the hotel) I have seen a few phosphatic nodules and bones, and Prof. Prestwich has recorded remains of this bed that he saw at an earlier period,* and which are now probably destroyed.

I was told that about 100 tons of "coprolites" had been got from a pit just N.E. of (and below) the house at the Dovercourt Cement Works.

Mr. W. Colchester, F.G.S., has supplied me with the following note of the quantity of phosphatic nodules that have been raised in Essex:—

Wrabness cutting and glebe, about 1,000 tons. Little Oakley; Rectory glebe, about 300; S.E. of village (Car-

* *Quart. Journ. Geol. Soc.*, vol. xxvii., p. 326.

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rington's and Norman's farms), about 1,000. Patches between Harwich and Little Oakley, about 2,000.

Harwich (Beacon Hill).

The following description of the cliff near Harwich is interesting not only from its age, but because it shows the former occurrence of a patch of Crag now destroyed by the encroachment of the sea.

"At the bottom of this Cliff, there is a *Stratum* of Clay about a foot thick, which is succeeded by another of Stone for a foot or more; in this *Stratum* of Stone are imbedded divers Shells, ... and also pieces of Wood . . . . Over this are divers Strata of blueish Clay; . . . . this Clay hath *Pyrites* or *Copperas* Stones sticking in it, but no shells that I could observe. Above this are likewise divers *Strata*, which reach to within about two feet of the Surface, some of which are only of fine Sand, other small Stones and Gravel mixt with fragments of Shells, ... and in others small Pebbles are mixt . . . . neither do the *Strata's* with the Shells observe any order in their lying, being sometimes higher and sometimes lower in the Cliff; and sometimes two or three one above another with other *Strata's* of Sand, Fragments and Gravel between. Above all these is a covering of common Sandy Earth, which is about two foot thick."

"Before this Cliff, the Shoar, as far the ebbing of the Sea would permit my observation, was rudely paved with Stones."*

In 1829 the Rev. W. B. Clarke noticed a little Crag here (see p. 10) and in 1833 Dr. J. Mitchell observes that "on the top of the cliffs, about 20 years ago, was a patch of crag, which has been entirely destroyed."† Nevertheless Mr. J. Brown says of the fragment of Crag that was left at Harwich in 1841. "It is so reduced . . . . by the action of the waves, that only by close attention can it be traced."‡

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* S. Dale, *Phil. Trans.*, vol. xxiv. (No. 291), pp. 1568, 1569 (1704). Reprinted in "The History and Antiquities of Harwich and Dovercourt," pp. 18, 19. Ed. 2, 1732. Plate viii. of this work shows the cliff, with the various beds; pp. 273—296 of the Appendix are devoted to a description of the minerals and fossils found in this cliff, the fossils being illustrated by Plates x–xiii., which are very well drawn representations of Crag fossils.

† *Trans. Geol. Soc.*, Ser. 2, vol. v., p. 260.

‡ *Proc. Ashmolean Soc. Oxon.*, No. xviii., p. 14.

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When I saw this cliff a few fragments of shells at one spot on the top were all that remained.

4. Drifts.

Gravel and Sand.

It seems that the gravel of our district is of two ages, the greater part being apparently the remains of the former extension of the great plateau on the north and west, which is probably of Glacial age, and older than the Boulder Clay; whilst at the south the somewhat lower mass of the cliffs from Clacton to beyond Little Holland is of Post-glacial age, as well perhaps as some neighbouring patches. This however is a question of classification and of theory, in no way affecting the practical issue of the occurrence of gravel at certain spots, and may be left for future decision. Naturally it is difficult to decide the relative ages of various gravels, where we have neither overlying nor underlying Boulder Clay to guide us, and where differences of level are very slight, composition is of litle avail, as a newer gravel would naturally be made out of an older.

The gravel that I believe is mostly of the older sort, caps the London Clay of the higher grounds, its former continuity having been destroyed by denudation, which has left a number of isolated patches, the largest being on the line of hill from Great Oakley to Dovercourt, which indeed is almost wholly covered.

There are hardly any sections worthy of note. The long cutting on the Tendring Hundred Railway, a mile and more eastward of Thorpe Station, must have been the best inland section of Drift in the neighbourhood, but is now overgrown. There is coarse sand, mostly red and yellow, with gravel and with clayey layers. The London Clay may be seen at the bottom at both ends, and seems to occur all along.

At the top of the cliffs at Frinton there was, in 1871, a short section showing a few feet of light-coloured false-bedded sand, with a very little gravel scattered through it. On the S.E. of this there were also gravelly patches along the cliff-top, and for about a mile south-eastward from Walton I also noticed irregular patches of gravel and sand over the London Clay and often capped by a clayey soil. These patches are quite unmappable, and the occurrence of the like inland, where there

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are no good sections, greatly adds to the difficulty of mapping gravel.

On the cliff at the Naze, and for about half a mile southward, the gravel may be well seen, and here I tried to estimate its composition, with the following result:—

Percentage of stones composing the gravel in a pit on the top of the cliff due east of Walton Hall.

Flints	52·6
Flint-pebbles	23·7
Quartz-pebbles	12·8
Chert and sandstone (from Lower Greensand ?)	8·3
Pebbles, undetermined, very hard, ? quartzite	2·6

The very small pebbles were mostly unnoticed in this estimation; there were no large stones.

Sections also occurred in the following places: The cuttings on the Harwich Railway at Wrabness and Copperas Wood; in pits nearly half a mile N.W. of Kirby Cross (sand and fine gravel), about two thirds of a mile N.E. of Thorpe Cross (fine gravel), about the same distance W. of Little Oakley church, close to Hick's Hall (N.W. of Little Oakley), and in a large old pit further east, which has been dug through to the London Clay, and east of South Hall (Ramsey).

Of the presumably newer deposit there is an almost continuous section along the low cliffs from Holland Gap westward, which indeed are mainly composed of a thick mass of false-bedded gravel and sand, with London Clay at the base. This latter, however, sometimes comes up to or near to the surface, as nearly half a mile S.W. of Little Holland and on the S. and E. of "Thurrowgood's Farm."

The patch of gravel in the hollow between Beacon Hill and the Redoubt (Harwich) would seem by position to be Post-glacial, as well as the dot by the railway on the west.

Loam or Brickearth.

The thin deposits of loam in the district seem, like the gravel, to be of two ages, and in this case the difference of level is more marked. We have an ill-defined loamy soil associated with, and to some extent masking, the gravel of the higher grounds, as between Thorpe and Kirby Cross, and on the north of Beaumont; and where this loam takes a more clayey character, as in the railway-

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cutting two thirds of a mile west of the latter place, it is so like the weathered surface of some of the London Clay as to add materially to the difficulty of mapping the Drift. Of this high level loam there are no good sections, as it is of little thickness or importance.

At lower levels, bordering the alluvial flats, there are occasional loamy patches, also very thin, but sometimes worked for bricks. The lower part of Walton-le-Soken is on one of these, which stretches out to sea, on the foreshore, as also does the alluvium that crosses it. It is worked on the north of "the Terrace."

In a short description of the coast from Walton to Harwich Mr. J. Brown says "The till, or argillaceous detritus, is only found at one locality along this part of the coast, namely at Walton, where it occupies the whole width of what is called the Gass. It is this stratum which contains the numerous fossil bones of Mammalia which have rendered Walton so famous."* The deposit in question is most likely the clayey brickearth that skirts the alluvium; at all events there is nothing to be seen that can be classed with the Glacial Drift, or "till," as it is called in the above quotation.

North of the Naze is another thin patch of loam, overlying the London Clay, which latter is to be seen beneath it along the very low ledge that skirts the beach.

At the brickyard N.E. of "Thurrowgood's Farm," near the coast westward of Little Holland, there was clay, with sand below, but the London Clay is touched in places at a depth of only 5 feet.

In the little valley running southwards from the Dovercourt Cement Works loam and sand were worked for brick-making (1872).

5. Recent Deposits.

Alluvium.

Of the marshland or modern river-deposit there is a broad spread in the estuary of Handford Water, great part of which has been reclaimed and protected from the tidal incursion of the sea. It is where the alluvial clay occurs out at sea, on the foreshore at the mouth of streams, that "submerged forests" are to be seen under certain favourable conditions, but I do not know of

* *Proc. Ashmolean Soc. Oxon.*, No. xviii., p. 14 (1841). For a list of the bones found here see p. 82.

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their having been noticed in this district, though they are almost sure to be present, and indeed a very good example occurs at Clacton, just to the west, which will be described by my colleague Mr. Dalton, in the Explanation of map 48, S.W.

The alluvium on which Harwich is built seems to be marine sand, judging from the well-section (p. 22), and I saw sand in excavations for foundations on the high road at the southern end of the town.

Blown Sand and Shingle.

Of these shore-deposits there is but little in our district. Walton Marshes are fringed seaward by two strips of sand with a little shingle and shells, and a trifle of blown sand, all deposited over the alluvium. At Stone Point, just N.W., there is a small mass of blown sand, the result of the action of the wind along the shore to the S.E., and on the opposite side of the estuary are other patches, mostly very small.

On the south, in the neighbourhood of Little Holland, the shore is of sand and shingle, with London Clay cropping out below on the west. On either side of Walton there is a narrow strip of shingle and sand at the foot of the cliff, with a foreshore of London Clay, and at Lower Dovercourt there is a fair spread of sand, also with London Clay cropping out below.

Of the deposit described in the following note I could see no trace. It must be either hidden by buildings or destroyed.

At Walton Gap there is a bed of "clay with boulders "of various kinds and sizes, the surface of which is "about five or six feet above high-water mark. The "beds containing shells, and supposed to form a raised "beach, are seen to rest immediately on this till, or "boulder clay, and the shells consist chiefly of *Ostrea* "*edulis* . . . *Mytilus edule*, and other abundant "coast shells . . . for the most part quite perfect, "and . . generally covered with sand, or with a "freshwater bed, about five feet thick."

There is "a bed of *Turbo littoreus* (*Littorina littorea*) "on the spot now occupied by the terrace at Walton."*

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* J. Brown. *Proc. Geol. Soc.*, vol. iv., p. 523, or *Quart. Journ. Geol. Soc.*, vol. i., p. 341.

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6. Physical Features.

Of the physical features of the small tract described above little can be said. It is essentially a clay-country, with gentle slopes, nowhere probably reaching to a greater height than 120 feet above the sea, the higher ground being for the most part flat, from the cappings of gravel, the remains of a once continuous plateau. The slopes mostly sink into alluvial flats, which are to a great extent below the level of high water, and are protected only by artificial embankments.

On the north and east this clay-tract is in great part abruptly cut off by the sea or the river Stour, cliffs being then formed. From the yielding nature of the beds these sea-cliffs suffer greatly from denuding agencies, those of a subaërial nature (rain, frost, &c.), causing the fall of large masses, which are soon removed by the sea. The following account of the waste of the coast south of Harwich was taken from a Report by Capt. Washington (1844). "The cliff on the western side "of the harbour is about 1 mile long and 40 feet high, "and the encroachment of the sea appears to have been "at the rate of 1 foot per annum between the years 1709 "and 1756. Between 1756 and 1804 the advance "increased to nearly 2 feet per annum. . . . . Between "1804 and 1844 the encroachment of the sea averaged "10 feet per annum."* The Harwich coast is now well protected, but elsewhere the waste continues.

* *Phil. Mag.*, Ser. 4, vol. v., p. 267 (1853).

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APPENDIX 1.—WELL SECTIONS.

DOVERCOURT. Waterworks. Close to the edge of the Marsh south of the Village.

From specimens at the Waterworks; some that are doubtful have their descriptions enclosed in brackets.

Shaft 27 ft., the rest bored.

Water close to the surface; is pumped down 17 ft.; supply abundant.

		ft.
[London Clay, 37 ft. or more.]	Light-grey sandy clay	at 20
	Brown loam (with pyrites?)	„ 26
	[Basement-bed] (Buff Sand)	„ 30
	[Basement-bed] (Light-brown or buff sand, a flint pebble)	„ 31
	[Basement-bed] (Buff sand with a little clay and small nodules of race)	„ 36
	[Basement-bed] (Clayey sand with very small calcareous nodules or race, almost a pisolite)	„ 37
[Reading Beds, about 50 feet.]	(Grey mottled clay)	„ 40
	(Buff sand)	„ 42
	Brown and grey clay	„ 43
	Brown sandy clay or clayey sand	„ 45
	(Brown clay) [depth not marked.]	
	Light-brown sandy clay or clayey sand	„ 56
	Light-brown clay	„ 60
	Brown clay	„ 68 (and below)
	Brown clay, mottled grey	at 77
	Grey clay	„ 79
	Red and green mottled sandy clay	„ 84
	Red and green mottled sandy clay or clayey sand.*	„ 86
Chalk		from 88 to 393
	Total depth	400

* There is an unmarked specimen of this last with green-coated flints.

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Harwich.

Prof. Sedgwick. *Ann. of Phil., ser. 2, Vol. III., p. 252* (1822).

"First Section in the town of Harwich."

		ft.	in.
[Recent and Tertiary.] 80 feet.	Soil	3	0
	Sand, a strong spring of salt water	17	0
	Blue clay	20	0
	Shingle and gravel	20	0
	Red coarse sand	7	0
	Coarse gravel	4	0
	Coarse dark sand	6	0
	Green and red clay	1	2
	Green clay	1	10
Chalk, 276 ft.	Chalk	28	0
	Chalk mixed with fine sand	0	9
	Chalk, grey from the mixture of dark sand; several flints and pieces of septaria	72	0
	Pure carbonate of lime	176	0
	Work then abandoned, at	356	9

"Second Section, commencing 198 feet south of the preceding, and eight feet above the High Water Mark."

	ft.
Soil	4
Sand containing salt springs	12
Blue clay containing selenite, &c.	74
Gravel with vegetable matter	Unknown

Harwich. West Street. [Before 1826.]

Rev. W. B. Clarke, *Trans. Geol. Soc., ser. 2, vol. V., p.* 370., reprinted (with some errors) in W. H. Lindsey's "Season at Harwich," Part 2, p. 145.

		ft.
Diluvium-earth		3
Sand (salt spring)		12
London clay, "Platamore"		9
Reading Beds, 40 ft.	Shingle and gravel	12
	Red sand	9
	Coarse gravel	6
	Coarse dark sand	9
	Green and red clay, mixed	1½
	Green clay	2½
	To Chalk	64
Chalk, 293 ft.	Chalk, with pyrites and *echini*	30
	Chalk and a peculiar white sand	10
	Chalk, with shells	72
	Chalk marl [marly chalk]	60
	Boring continued	121
		357

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A newer boring, began in 1826, left off in 1827, 70 yards north of the above (same authority.)

		ft.
* London Clay, greyish, marly		70
Reading Beds	Compact clay (mottled red and lilac)	10
	Fine sand, with salt water	8
	To Chalk	88
Chalk		192
		280

HARWICH. By the harbour, just west of the Great Eastern Hotel. 1854–7.

Prestwich. *Quart. Journ. Geol. Soc., vol.* xiv., *p.* 249; and Bruff, *Proc. Inst. Civ. Eng. vol. xix., p.* 21.

Six feet above high-water mark.
Shallow shaft, the rest bored.

Earth [made ground, mud ?]		10
Red gravel		15
London Clay. Platimore, mixed with chalk and white sand †		23
Reading Beds, 30 ft.	Coarse dark gravel	10
	Plastic clay	7
	Bluish plastic clay, with green sand (1)	1½
	Red plastic clay, with green sand (1)	3½
	Greenish sand (1)	2
	Greenish and red sand (1)	3
	Dark red (or blue) clay	3
	To Chalk	78
Chalk, 890 ft.	Chalk with flints in layers 5 or 6 ft. apart, and with shells	690
	Chalk without flints (2)	162
	Chalk Marl with thin layers of rocky chalk	38
Gault mixed with Greensand		22
Gault		39
	To hard rock	1,029
Hard dark bluish-grey slaty rock (3) [some of the specimens of this seem to show planes of bedding, cleavage, and jointing]		69
		1,098

The beds marked (1) are thus massed in Mr. Prestwich's account:

Bluish clay with green sand	3½
Green and red sand intermixed	5

The bed marked (2) is given as 160 ft.
" (3) " 44½ ft.
Making the depth to the chalk 76½ ft., and the depth to the hard rock 1,025½ ft.

PEWIT ISLAND. Marshland, 4 miles S.S.W. of Harwich. 1869.
From information on the spot.

* [Part of this must belong to the Reading Beds.]
† [?Reading Beds in part.]

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Bored throughout.

Water to the surface of the ground (below the level of high-water). Supply abundant.

	ft.
To Chalk - - -	110
In „ - - -	75
	185

According to a note from Mr. H. Miller of Ipswich, beds of cement-stone were met with at depths of 20 and 80ft.; and the depth to the Chalk was only 100½ ft.

THORPE. Malting, N.W. of the Railway Station. 1876.

Communicated by Mr. P. Bruff, C.E.

Surface 35 ft. above low-water mark.

Shaft 50 ft., the rest bored.

Water found at a depth of 370 ft., rose to within 20 ft. of the surface.

		ft.
[London Clay]	Platimore, as on the shore at Walton [clay] with stone [cement-stone], 11, 8, and 18 in. thick, at depths of 58, 70, and 90 ft.	109
	[Basement-bed.] Sand - - -	2
	[Basement-bed.] Fine brown sand - -	
	[Basement-bed.] Yellowish sandy loam with small flint stones [pebbles.]	15?
[Reading Beds]	Brown coloured clay - - -	14
	Yellowish sandy loam - - -	7?
	Brown clay - - - -	
	Brown clay - - - -	3
	Dark (nearly black) fine sand - -	38?
	*Green platimore - - - -	
	*Green platimore, half clay and half chalk -	1
	To flints and chalk -	189
Chalk - - - - - - - - - -		181
		370

WALTON-LE-SOKEN. Waterworks, close to and below the Railway Station, 1858? (to 120 ft.), deepened 1868.

From specimens at the Waterworks.

Surface 48 ft. above low-water mark.

Shaft 60 ft., the rest bored.

Water 40 ft. down, hardly affected by pumping.

		ft.
[London Clay, 116 to 119 ft.]	Cement-stone - - -	at 92
	Sandy clay - - - -	„ 107
	[Basement-bed.] Black flint pebbles in fine brown sand (clayey?) - -	„ 115
	[Basement-bed.] Smaller black flint pebbles (in hard brown clay?) - -	„ 116

* [A specimen from one of these beds showed the clayey green sand that usually occurs at the junction of the older Tertiary beds and the Chalk.]

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		ft.
[Reading Beds, 57 to 61 ft.]	Brownish clay	at 120
	Red mottled sandy clay	„ 123
	Brownish clay	„ 126
	Specimens missing (said to be clays)	„ 128 & 132
	Brownish clay	„ 150
	Very sandy buff clay	„ 154
	Sandy clay	„ 156
	Buff clayey sand	„ 157
	Grey sand, less clayey	„ 158
	Grey clayey sand, streaked with red	„ 159 & 161
	Red clay and greenish-grey clayey sand, mixed	„ 163
	Red clay with a little calcareous earth	„ 164 & 165
	Red and grey mottled clay	„ 171
	Grey clay, mottled with brown	„ 172
	[Bottom-bed] green-coated flints in very clayey green sand	„ 176
Chalk	Flints (a bed of about 18 inches)	„ 177 & 178
	Chalk	„ 200 to 400

TRIAL-BORINGS along low-water mark of the RIVER STOUR by RAMSAY RAY, or RAY ISLAND, W. of HARWICH. Made for the Great Eastern Railway Company 1875. Communicated by Mr. J. B. Crawford.

1. N.N.E. of the east end of the island, 2¾ ft. above low water of spring tides:

	ft.
Soft black mud [alluvium]	28½
Sand and gravel [? River Drift]	11½
	40

2. N.N.W. of the east end of the island, 2½ ft. above low water of spring tides:

		ft.
[Alluvium]	Soft black mud	28½
	Peat	1
[? River Drift]	Fine sand	1½
	Sand and gravel	11½
Left off in a bed of flints, with hardly any sand, at		42½

3. North-westward of the east end of the island, 4 ft. above low water of spring tides:

		ft.
Soft black mud [alluvium]		25½
[River Drift]	Sand	1
	Sand and gravel	8¼
		34¾

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APPENDIX 2.—FOSSILS.

Fossils from the London Clay of Harwich.*

Mammalia.

Coryphodon Eocænus, *Ow.* Pliolophus vulpiceps, *Ow.*

Reptilia.

Chelone crassicostatus, *Ow.* C. planimentum, *Ow.*

Mollusca.

Nautilus Parkinsoni, *Edw.*
Scalaria reticulata, *Brand* (not *Sby.*) = S. semicostata, *Sby.*
Modiola undulata, *Wood.*

Plants.

Remains of stems in iron-pyrites very plentiful. Wood in the state of lignite.

Fossils from the Red Crag.

The column for Beaumont is from Mr. J. Brown's list (see p. 11), corrected according to the Monographs of the Palæontographical Society.

The column for Walton Naze is taken from the works of the Palæontographical Society, with some additions (all being marked as such) chiefly from Mr. Prestwich's paper, in Quart. Journ. Geol. Soc., vol. xxvii., pp. 480–493 (marked P.).

In W. H. Lindseys "Season at Harwich," (London, 1851), part II., pp. 150–153, is a long list of Crag fossils, some from Harwich.

a. = occurs above the Red Crag.
b. = „ below „ „

		Walton Naze.	Beaumont.
	Mammalia.		
	Given as on the authority of Prof. Owen. — Bone of small cetacean	.	×
	Given as on the authority of Prof. Owen. — Ear-bone of Balæna emarginata	.	×
	Given as on the authority of Prof. Owen. — Premolar of small mammal	.	×
	Ribs of Whales, from the nodule-bed at the bottom	×	
	Fish.		
	[Derived from London Clay.]		
	Teeth of Lamna and Myliobatis	.	×
	Vertebræ of fish	.	×
	Gasteropoda.		
? *a.*	Actæon ? Etheridgii *Bell* (= A.exilis, *Jeff.*)	×	
	„ Noæ, *Sby.*	×	
a. b.	Adeorbis subcarinatus, *Mont.*	×	
	Aporrhais pes-pelicani, *Linn.*	×	
a. b.	Buccinum Dalei, *Sby.*	×	×
	„ elongatum (?)	.	×

* In W. H. Lindsey's "Season at Harwich," (London, 1851) Part ii., pp. 148, 149, is a long list of shells, "found at Harwich, according to Mr. Farey," but I do not know whether it can be depended on.

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		Walton Naze.	Beaumont.
a.	Buccinum glaciale, *Linn.*	×	
a. b.	„ undatum, *Linn.* ?	×	
a.	„ „ var. striatum, *Penn.*	×	
a.	„ „ „ tenerum	×	×
a. b.	Calyptræa sinensis, *Linn.*	×	×
	Cancellaria coronata, *Scacchi.*	×	
b.	Capulus obliquus, *Wood*	×	
a. b.	„ recurvatus, *Wood*	×	
a. b.	„ Ungaricus, *Linn.*	×	×
	Cassidaria bicatenata, *Sby.*	.	×
b.	Cerithiopeis metaxa, *Delle Chiagi.* P.	×	
	Cerithium funatum, *Mant.* funiculatum, *Sby.*	.	×
b.	„ granosum, *Wood*	×	
a. b.	„ perversum, *Linn.*	×	×
a.	„ reticulatum, *Da Costa?*	×	
a. b.	tricinctum, *Broca.*	×	
a. b.	„ trilineatum, *Phil.*	×	
	„ variculosum, *Nyst*	×	
a. b.	Chemnitzia densecostata, *Phil.* P.	×	
b.	„ elegantior, *Wood* (? elegantissima, *Montf.* in Prestwich, ? Parthenia elegans from Beaumont)	×	× ?
a. b.	„ internodula, *Wood*	×	
	„ plicatula ? *Broc.*	×	
	„ rugulosa, *Wood*	×	
	Columbella Borsoni ?, *Bellardi*	×	
	„ scripta, P.	×	
b.	„ sulcata, *Sby.*	×	
b.	Cypræa avellana, *Sby.*	×	×
a. b.	„ Europæa, *Mont.*	×	×
a. b.	Dentalium dentalis, *Linn.* (= D. costatum, *Sby.* and D. striatum, *Mont.*)	.	×
a. b.	Emarginula fissura, *Linn.*	×	×
a.	„ „ var. rosea, *Bell.*	×	
	Eulima distorta, P.	×	
a. b.	„ intermedia, *Contraine*	×	
a. b.	„ polita, *Linn.*	×	×
?a.	„ similis ? *D'Orb*	×	
a. b.	„ subulata, *Donovan* or *Mont.* (= Melania Cambesedesii)	.	×
	Eulimella acicula, *Phil.*	×	
	Eulimene pendula, *Wood*	×	× ?
	„ terebellata, *Nyst.*	×	
a. b.	Fissurella græca, *Linn.*	×	×
	Fusus (Pisania) interruptus	.	×
	„ sexdentatus	.	×
	„ striatus	.	×
	(For other species of Fusus see Trophon.)		
	Helix rysa, *Wood*	×	
a. b.	Hydrobia ulvæ, *Penn.* P.	×	
	Lacuna suboperta, *Sby.*	×	
	Lepeta cæca, *Müll.*, P.	×	
?	Littorina littorea, *Linn.*	.	×
	„ suboperta, *Sby.*	×	×
b.	Margarita maculata, *Wood*	×	
	Melampus pyramidalis, *Sby.*	×	
	Menestho albula, *Fabr.* P.	×	
b.	Murex tortuosus, *Sby.*	×	
?a.	Nassa conglobata, *Broc.*	×	
	„ costata, *Wood*	.	×
	„ elegans, *Leathes*	×	×
a. b.	„ granulata, *Sby.*	×	×
	„ incrassata, *Müll.*	.	×
	„ labiosa, *Sby.*	.	×

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		Walton Naze.	Beaumont.
? *a. b.*	Nassa prismatica, *Broc.*, var. limata (Walton)	×	×
	„ propinqua, *Sby.*	×	×
	„ reticosa, *Sby.* (and many varieties, Walton)	×	×
	Natica catenoides, *Wood*	×	
b.	„ helicina, *Broc.*	×	
	„ hemiclausa, *Sby.*	×	×
b.	„ multipunctata, *Wood*	×	×
	Odostomia aciculata, *Phil.*, P.	×	
b.	„ acuta, *Jeff.*, P.	×	
a. b.	„ conoidea, *Broc.*	×	
a. b.	„ plicata, *Mont.* (? plicatula P.)	×	
a.	„ unidentata, *Mont.*	×	
a. b.	Ovula spelta, *Linn.* (= Leathesii P.)	×	
?*a.*	„ „ var brevior	×	
	Paludestrina pendula, *Wood*	×	
a. b.	Pleurotoma* cancellata, *Sby.*	×	
a. b.	„ costata, *Da Costa*	×	
a. b.	„ hystrix, *Jan.*	×	
	„ interrupta, *Broc.* ? (Murex)	.	×
a. b.?	„ lævigata, *Phil.*	×	
a.	„ Leufroyii, *Mich.*	×	
a. b.	„ linearis, *Mont.* P.	×	
? *a. b.*	„ mitrula, *Sby.*	×	
? *a. b.*	„ modiola, *Jan.*	×	
b.	„ perpulchra, *Wood*	×	
a. b.	„ Philberti, *Mich.*	×	
	„ tenuistriata, *A. Bell*	×	
a.	„ turricula, *Mont.*	×	×
a.	Purpura incrassata, *Sby.*	×	
a.	„ lappillus, *Linn.* (crispata)	×	×
	„ tetragona, *Sby.*	×	×
b.	Pyramidella læviuscula, *Wood*	×	
? *a. b.*	Pyrula reticulata, *Lam.* (= P. acclivis *Wood.*)	×	
b.	„ uniplicata, *Duj.* P.	×	
? *a. b.*	Rissoa Stefanisi, *Jeff.*	×	
a. b.	„ Zetlandica, *Mont.*	×	
b.	Rostellaria lucida, *Sby.* } [Derived from London Clay]	.	×
b.	„ Parkinsoni }		
b.	Scalaria funiculus, *Wood* (S. varicosa *Lam.* P.)	×	
b.	„ Grœnlandica, *Chemn.* (= similis, *Sby.* and subulata, *Couthouy.*)	.	×
? *a. b.*	„ subulata, *Sby.*	×	×
a. b.	Tectura fulva, *Müll.*?	×	
a.	„ virginea, *Müll.*	.	×
	Terebra inversa, *Nyst* (= heterostropha, Wood)	.	×
b.	Trochus bullatus, *Phil.*	×	
a.	„ cinerarius, *Linn.*	×	
	„ cinereides, *Wood*	×	
a.	„ granulatus, *Born.* (= similis, *Sby.*)	×	× ?
a. b.	„ millegranus, *Phil.*	×	
a. b.	„ noduliferens, *Wood* (= granosus, *Wood* & papillosus, *Da Costa*)	×	× ?
	„ subexcavatus, *Wood*	×	
b.	Trophon alveolatum, *Sby.*	.	×
a.	„ (Neptunea) antiquus, *Linn.*, var. striatus contrarius	×	×
a.	„ Barvicensis, *Johnston*	×	
? *a. b.*	„ costiferum, *Nyst.* (? = rugosus, *Sby.*)	×	× ?
a. b.	„ gracilis, *Da Costa*, P. (= corneus)	×	×
a.	„ (Sipho) Jeffreysianus, *Fischer*	×	

* Sometimes *Clavatula* or *Defrancia*.

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		Walton Naze.	Beaumont.
a. b.	Trophon (Sipho) propinquus, *Alder* - - -	×	
a.	„ muricatus, *Mont.* - - - -	×	
a.	„ scalariformis, *Gould* - - -	.	×
a. b.	Turritella incrassata, *Sby.* - - - -	×	×
a. b.	Voluta Lamberti, *Sby.* - - - -	×	×
	LAMELLIBRANCHIATA.		
a. b.	Abra (Scrobicularia) alba, *Wood* - - -	×	×
	„ fabalis, *Wood* - - - - -	×	
a. b.	Anomia ephippium, *Linn.* - - - -	.	×
a. b.	„ patelliformis, *Linn.* - - - -	×	
a. b.	Arca lactea, *Linn.* (? = lactanea) - - -	×	× ?
? b.	Artemis lentiformis, *Sby.* - - - -	×	×
a. b.	„ lincta, *Pult.* - - - -	×	
b.	Astarte Basterotii, *Dela Jonk.*? (= nitida) - -	×	×
a.	„ borealis, *Chemn.* - - - -	.	+
b.	„ Burtinii, *Dela Jonk.* - - -	.	×
a.	„ compressa, *Mont.* - - - -	×	
	„ crebrilirata, *Wood* - - - -	+	
	„ obliquata, *Sby.* - - - -	×	×
b.	„ Omalii, *Dela Jonk.* - - - -	.	×
a. b.	„ triangularis, *Mont.* - - - -	×	
b.	Cardita anceps, *Wood* - - - -	×	
b.	„ chamæformis, *Leathes*? - - -	×	+
a. b.	„ corbis, *Phil.* - - - - -	×	×
b.	„ orbicularis, *Leathes* - - - -	.	×
a. b.	„ scalaris, *Leathes* - - - -	×	×
b.	„ senilis, *Lam.* - - - -	.	×
	Cardium angustatum, *Sby.* - - - -	.	×
b.	„ decorticatum, *Wood* (? venustum) - -	.	×
a. b.	„ edule, *Linn.* - - - -	×	×
	„ Parkinsoni, *Sby.* - - - -	×	×
	„ venustum, *Wood* - - - -	×	
b.	Chama gryphoides, *Linn.*, P. - - -	×	
	Cochlodesma complanatum, *Wood* - - -	×	
a. b.	Corbula striata, *Walker and Boys* - - -	×	×
b.	„ tenuis, P. - - - - -	×	
? b.	Corbulomya complanata, *Sby.* - - -	×	×
	Cultellus cultellatus, *Wood* - - - -	×	
a. b.	Cyprina Islandica, *Linn.* ? - - - -	×	
a. b.	Cytherea rudis, *Poli.* - - - -	×	
a. b.	Diplodonta rotundata, *Mont.* - - -	.	×
a. b.	Donax politus, *Poli.* - - - - -	.	×
a. b.	Erycinella ovalis, *Conrad* ? - - - -	×	
? a. b.	Gastrana laminosa, *Sby.* - - - -	×	×
a. b.	Gastrochæna dubia, *Penn.* - - - -	.	×
b.	Glycimeris angusta, *Nyst.* - - - -	.	×
a. b.	Kellia suborbicularis, *Mont.* - - - -	×	
a. b.	Leda pygmæa, *Münst.* - - - -	×	
b.	Lima exilis, Wood - - - - -	×	
a. b.	„ Loscombii, *Sby.* - - - -	×	
a. b.	Limopsis pygmæa, *Phil.*, (Pectunculus) - -	×	×
a. b.	Lucina borealis, *Linn.* - - - -	×	×
a. b.	Lutraria elliptica, *Lam.* - - - -	.	×
b.	Mactra arcuata, *Sby.* - - - -	×	×
a.	„ (Mesodesma) deaurata. *Turt.* - -	×	
a. b.	„ ovalis *Sby.*, P. (everywhere *except* Walton according to Wood).	×	
a. b.	„ solida, *Linn.* - - - - -	×	×
a. b.	„ stultorum, *Linn.* - - - -	×	
a.	„ truncata, *Mont.* - - - -	×	

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		Walton Naze.	Beaumont.
a.	Modiola barbata, *Linn.*	×	
a. b.	Modiola costulata, *Risso*	×	
a. b.	„ marmorata, *Forb.*	×	
a. b.	„ Petagnæ, *Scac.*	×	
a. b.	Montacuta bidentata, *Mont.*	×	
a.	Mya arenaria, *Linn.*	.	×
a. b.	„ truncata, *Linn.*	.	×
a.	Mytilus edulis, *Linn.*	.	×
	Nucula lævigata, *Sby.*	×	×
a. b.	„ tenuis, *Mont.* P.	×	
a. b.	Ostrea edulis, *Linn.*	×	
a. b.	Pandora inequivalvis, *Linn.*	×	
b.	Pecten dubius, *Broc.*	×	
a. b.	„ maximus, *Linn.*	.	×
a. b.	„ opercularis, *Linn.*	×	×
a. b.	„ pusio, *Penn.*	×	×
a. b.	„ tigrinus, *Müll.*	×	
a. b.	Pectunculus glycimeris, *Linn.*, P.	×	×
a.	Pholas crispata, *Linn.*	×	
	„ cylindrica, *Sby.*	×	
a.	„ dactylus, *Linn.*	×	
	„ lata ?	.	×
	„ parva, *Penn.*, P.	×	
a. b.	Pinna pectinata, *Mont.* ?	×	
? b.	„ rudis, *Linn.*, P.	×	
a. b.	Saxicava arctica, *Linn.*	×	
a. b.	„ „ var. rugosa, *Linn.*	×	
b.	Scintilla (Kellia) ambigua, *Nyst.*	×	
	Solen complanata ?	.	×
a. b.	„ ensis, *Linn.*	×	
a.	„ gladiolus, *Gray*	×	
a.	Sphenia Binghami, *Turt.*	×	
a. b. ?	Tapes pullastra, *W. Wood* ?	×	
a.	„ texturatus, *Lam.*	×	
a. b.	„ virgineus, *Linn.*	×	
a. b.	Tellina crassa, *Gmel.*	×	
	„ lata, *Gmel.*	.	×
a. b.	„ obliqua, *Sby.* ?	×	×
a.	„ prætenuis, *Leathes* ?	×	
a. b.	Venerupis Irus, *Linn.*	×	
a.	Venus fasciata, *Da Costa*	×	
	„ imbricata, *Sby.*	×	×
a. b.	Woodia (Astarte) digitaria, *Linn.*	×	
	Brachiopoda.		
b.	Terebratula grandis, *Blum.*	×	
	„ variabilis ?	.	×
	Polyzoa.		
	[Probably derived from Coralline Crag.]		
	Cellepora pumicosa	.	×
b.	Eschara monilifera, *W. Edw.*	.	×
b.	Heteropora lævigata, *D'Orb.*	.	×
	„ septosa	.	×
b.	Hornera reteporacea, *M. Edw.*	.	×
b.	„ striata, *M. Edw.*	.	×
b.	Lunulites conica, *Defr.*	.	×
	Melicerita Charlesworthi, *M. Edw.*	.	×

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		Walton Naze.	Beaumont.
	ECHINODERMATA.		
b.	Echinocyamus hispidulus, *Forb.* * - - -	×	
b.	„ oviformis, *Forb.** - - -	×	
	„ Suffolciencis, *Ag.* - - -	×	×
	Echinus Henslovii, *Forb.* - - - -	×	
	CRUSTACEA.		
	Fragments of carapaces and claws of Crabs and Lobsters. [? Derived from London Clay.]	.	×
	ENTOMOSTRACA.		
	Bairdia subdeltoidea, *Münst.* - - - -	×	
	Candona laqueata, *Jones* - - - -	×	
	„ trachypora, *Jones* - - - -	× ?	
	Cytherideis tuberculata, *Jones* - - -	×	
	CIRRHIPEDIA.		
	Balanus - - - - - -	.	×
	ANNELIDA.		
	Ditrupa subulata ? - - - - -	.	×
	Serpula - - - - - -	.	×
	Vermetus Bognoriensis [? derived from London Clay].	.	×
	CŒLENTERATA.		
	Alveolites ? - - - - -	.	×
	Balanophyllyia calyculus, *Wood* - - -	.	×
	Madrepora tubulata - - - - -	.	×
	Sphænotrochus intermedius, *Münst.* - - -	.	×

* On the authority of Mr. A. BELL, *Ann. and Mag. Nat. Hist., Ser.* 4, vol. vi., p. 217.

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Fossils from Pleistocene Beds.

D.— On the authority of Prof. W. B. Dawkins, *Quart. Journ. Geol. Soc.*, vol. xxv., p. 194. The rest from a MS. list of the late Dr. S. P. Woodward, communicated by his son Mr. H. B. Woodward.

For a note of the Walton deposit see p. 18. Of that at Harwich I know nothing personally. Prof. Dawkins tells me that most of the Harwich bones were dredged, and that the *Bos longifrons* must have been derived from alluvium, the species being distinctly non-Pleistocene.

		Walton.	Harwich.
	Mammalia.		
D.	Bison priscus, *Bojar.*	×	
	Bos longifrons, *Ow.* (given as B. brachyceros.)	×	
D.	Bos primigenius, *Bojar.*	×	
	Castor	.	×
D.	Cervus elaphus, *Linn.*	×	
D.	„ megaceros, *Hart.*	×	
D.	Elephas antiquus, *Falc.*	×	×
D.	„ primigenius, *Blum.*	×	×
D.	Equus caballus	×	
D.	Felis spelæa, *Goldf.*	×	
D.	Hippopotamus major, *Desm.*	×	
D.	Hyæna spelæa, *Goldf.*	×	
D.	Rhinoceros leptorhinus ?, *Cuv.*	×	
D.	„ tichorhinus ?, *Cuv.*	×	
D.	Ursus spelæus, *Blum.*	×	

Mollusca.

From Harwich. On the authority of Dr. Woodward (as above).

Bithinia tentaculata
„ ventricosa
Clausilia nigricans
Helix pulchella
„ spinulosa [or aculeata]
„ (Zonites) cellarius
„ „ rotundatus
Limnæa peregra
„ truncatula.
Littorina
Planorbis albus
Valvata piscinalis
Vertigo pusilla
„ substriata
Pisidium pusillum.

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*Killenaule (Tipperary), 146.
(For Sections illustrating these Maps, see detailed list.)
* With descriptive Memoir.

GEOLOGICAL MAPS OF ENGLAND AND SCOTLAND.

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Lancashire.

47. Clitheroe.
48. Colne, Twiston Moor.
49. Laneshaw Bridge. Horiz. Sect. 62, partly illustrates
55. Whalley. this sheet.
56. Haggate. 6*s*. Horiz. Sect. 62, 85.
57. Winewall.
62. Balderstone, &c.
63. Accrington.
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85. Standish, &c.
86. Adlington, Horwick, &c. - „ 68. „
87. Bolton-le-Moors - - „ 67. „
88. Bury Heywood - - „ 66. „
89. Rochdale, &c. - - „ 66. „
92. Bickerstaffe, Skelmersdale.
93. Wigan, Up Holland, &c. - „ 68. „
94. West Houghton, Hindley, Atherton - - - „ 67. „
95. Radcliffe, Peel Swinton, &c. „ 66–67. „
96. Middleton, Prestwich, &c. „ 66. „
97. Oldham, &c. - - „ 64. „
100. Knowsley, Rainford, &c. „ 67–68. „
101. Billinge, Ashton, &c. - „ 68. „
102. Leigh, Lowton - - „ 67. „
103. Ashley, Eccles - - „ 66. „
104. Manchester, Salford, &c. - „ 64–65. „
105. Ashton-under-Lyne - „ 64–65. „
106. Liverpool, &c. - - „ 68. „
107. Prescott, Huyton, &c. - „ 68. „
108. St. Helen's, Burton Wood „ 67. „
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112. Stockport, &c. 4*s*.
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Sheets 84, 85. 92, 93, 100, and 101 are included in the one-inch Map 89 SW. and are described in the "Memoir of the Geology of the Country around Wigan." Second edition. Price 1*s*.

Lancashire—*cont.*

Sheets 86, 87, 88 (in part), 94, 95, 96 (in part), 102, 103, 104 (i part), are included in the one-inch Map 89 SE., and ar described in the "Memoir on the Geology of the Countr around Bolton-le-Moors."

Sheets 107, 108, are included in the one-inch Map 90 NW and are described in the "Memoir on the Geology of th Country round Prescott."

Sheets 88, 89, 96, 97, 104, 105, 111, 112, on the six-inch scal are included in 88 SW., and are described in a Memoir o the Geology of the Country around Oldham, includin Manchester and its Suburbs.

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Scale, six inches to a mile.

Sheet.
1. Ryton. 4*s*.
2. Gateshead. 4*s*.
3. Jarrow. 4*s*.
4. S. Shields. 4*s*.
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7. Washington.
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9. —— 4*s*.
10. Edmond Byers. 4*s*.
11. Ebchester.
13. Chester-le-Street. 6*s*.
14. Chester-le-Street.
17. Waskerley.
19. Lanchester. 6*s*. Vertica Section, 39.
20. Hetton-le-Hole.
25. Wolsingham.
26. Brancepeth.

Northumberland.

Scale, six inches to a mile.

47. Coquet Island. 4*s*.
56. Druridge Bay, &c.
65. Newbiggin. 4*s*.
68. Belingham.
69. Redesdale.
72. Bedlington.
73. Blyth. 4*s*.
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78. Ingoe. 6*s*.
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81. Earsdon.
84. Newborough.
85. Chollerton.
86. Matfen.
87. Heddon-on-the-Wall.
88. Long Benton.
89. Tynemouth.
95. Corbridge.
96. Horsley. 4*s*.
97. Newcastle-on-Tyne. 4*s*.
98. Walker. 4*s*.
109. Shotleyfield.

These Sheets are included in 105 NE., One inch.

Yorkshire.

201. Bingley.
246. Huddersfield.
260. Honley.
272. Holmfirth.
273. Penistone.
274. Barnsley.
281. Langsell.
287. Low Bradford.
293. Hallam Moors. 4*s*.

SCOTLAND.

Scale, six inches to a mile.

Edinburghshire.

2. Edinburgh, &c.
3. Portobello, Musselburgh, &c.
6. Gilmerton, Burdie House, &c.
7. Dalkeith, &c.
8. Preston Hall. 4*s*.
12. Penicuick, Coalfields of Lasswade, &c.
13. Temple, &c.
14. Pathead. 4*s*.
17. Brunston Colliery, &c
18. Howgate.

These Sheets are included in Sheet 32, One-inch scale.

8. Preston Hall, &c. 14. Fala, &c.

Haddingtonshire.

Six inches to a mile.

8. Prestonpans, &c. Price 4*s*.
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13. Elphinstone, &c. Price 4*s*.
14. Ormiston, East Salton, &c.

These Sheets are included in Sheet 32, One-inch scale.

Horizontal Sections 83, 63, and Vertical Section 28 illustrate these Six-inch Maps.

Fifeshire.

Six inches to a mile.

24. Markinch, &c.
25. Scoonie, &c.
30. Beath, &c.
31. Auchterderran. 4*s*.
32. Dysart, &c.
33. Buckhaven.
35. Dunfermline.
36. Kinghorn.
37. Kinghorn. 4*s*.

Ayrshire.

Six inches to one mile.

19. Newmilns.
26. Glenbuck. 4*s*.
27. Monkton, &c.
28. Tarbolton, &c.
30. Aird's Moss.
31. Muirkirk. 4*s*.
33. Ayr, &c.
34. Coylton.
36. Grieve Hill.
40. Chiltree.
41. Dalleagier.
43. New Cumnock.
46. Dalmellington.
47. Benbeock.
50. Daily.
52. Glenmoat.

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